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Perchlorate Concerns Shift from Regional to National

Drinking Water Systems Likely to Be Affected by Federal Regulation

by Mary Madison

Water suppliers around the country should expect to become increasingly familiar with a newly recognized contaminant—perchlorate.

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An important constituent of rocket fuel and pyrotechnics, ammonium perchlorate is as soluble as table salt when placed in water. Once dissolved, the resulting anion, perchlorate, moves easily through aquifers and into water bodies. If ingested, perchlorate inhibits iodide uptake by the thyroid gland and can cause developmental abnormalities. Once considered a regional issue, improved detection methods revealed that perchlorate contamination is widespread in the United States.

EPA's Office of Research and Development (EPA-ORD) has issued a reference dose (RfD) for perchlorate, and some states have promulgated health advisory/action levels, but there are currently no enforceable drinking water standards. Perchlorate is on the Contaminant Candidate List (CCL) of the Safe Drinking Water Act (SDWA), which requires large and selected small drinking water providers to monitor perchlorate levels until December 2003. As these occurrence data are gathered, EPA-ORD expects to finalize a revised draft health and ecotoxicological risk assessment in late 2002/early 2003. This assessment will provide a foundation for later regulatory or advisory decisions.

Perchlorate removal technologies are being explored in pilot and large-scale projects throughout the country, primarily at Superfund sites in the Pacific southwest. These emerging technologies are successful in treating contaminated water, but vary in their overall cost efficiency and effectiveness.

Perchlorate—What It Is and Where It Is

Perchlorate is typically manufactured as a compound - combined most often with ammonium. Because ammonium perchlorate is stable as a solid and is a strong oxidizer, it is the perfect ingredient in settings where sudden combustion is needed. Ninety percent of perchlorate is used in solid rocket fuel, but other uses include fireworks, flares, and vehicle airbags.

Perchlorate in the United States comes primarily from two manufacturers who have shipped it to more than 220 locations in 40 states (exceptions are Mont., Alaska, Hawaii, Ky., Del., Conn., R.I., Me., N.H., and Vt.). Releases have not yet been reported in all states receiving shipments. Kevin Mayer, who works with EPA's Superfund Program in Region 9, notes that so far, perchlorate shows up where detection efforts are focused, meaning, in time, more sites are likely.

As of June 2002, releases had been detected in 21 states: Ala., Ariz., Ark., Calif., Colo., Iowa, Ind., Kan., Md., Mich., Mass., Neb., Nev., N.M., N.Y., Ore., Pa., Tex., Utah, Wash., and W.V. In California, where the most aggressive testing is conducted, a survey of 4,000 water supply wells detected 255 perchlorate sources; of these, 49 show perchlorate at levels above 18 parts per billion (ppb).

Federal Perchlorate Regulation

Regulators first identified perchlorate as a possible contaminant at Superfund sites in California and Nevada in the early 1980s. These were locations where solid-fuel rockets were tested or manufactured, so perchlorate presence seemed likely. However, because perchlorate detection technologies and toxicological data were still developing, EPA had difficulty proving perchlorate was present, or what kind of health threat it posed.

In 1995, EPA-ORD issued guidance for an RfD of 0.0001 to 0.0005 mg/kg/day, which corresponds to a provisional drinking water concentration of 4 to 18 ppb. The RfD is an estimate of a daily exposure that would likely be safe over a lifetime for a 70 kg (154 lb) person who drinks 2 liters of water daily. It is still only an estimate, and the uncertainty range spans an order of magnitude. A lower RfD corresponding to a drinking water concentration of 1 ppb was proposed in 2002, but has not been adopted. The lower RfD is relevant, however, since a regulatory standard will bear a close resemblance to the final RfD and its corresponding drinking water concentration.

It was not until April 1997 that EPA reliably detected perchlorate at levels below 100 ppb. This marked the beginning of research strategies and the develop-

ment of a risk assessment database, created initially through partnerships with potentially responsible parties at the Rancho Cordova Superfund site.

Detected perchlorate at Rancho Cordova triggered increased public concern, and in 1998, EPA placed perchlorate on the federal CCL. The CCL was designed for contaminants "known or anticipated to occur in public drinking water systems and which *may* require regulation" (emphasis added). EPA's Office of Groundwater and Drinking Water (EPA-GW) sorts contaminants on the CCL according to the information needed (occurrence, health, etc.). Once sufficient information is available, EPA-GW decides whether or not to regulate. Perchlorate was placed on the CCL as a priority for additional research in analytical methods, occurrence, treatment technology, and health risk assessment.

Because perchlorate is on the CCL and made a priority for occurrence data, it falls under the 1999 Unregulated Contaminant Monitoring Rule (UCMR). Under UCMR, all large systems serving more than 10,000 customers (approximately 3,000 systems) and a sampling of 800 small systems must monitor for perchlorate for at least four consecutive quarters between January 2001 and December 2003. Here the small systems get some financial help - EPA pays for the sample shipping and analysis—but the large systems have to cover their own costs.

By law, EPA-GW has to review at least five contaminants within 3 1/2 years following their nomination to the CCL and decide whether or not to regulate them. EPA-GW recently reviewed nine contaminants and decided not to regulate any of them. Perchlorate was not among the nine, and EPA is not *required* to make another regulatory determination of CCL contaminants until 2006.

However, as data gaps are filled regarding the human and environmental effects of perchlorate contamination, EPA-GW will likely make a regulatory decision regardless of its required timeframe. Because perchlorate is a high-priority contaminant, and because a finalized toxicological assessment is imminent, EPA-GW has several options in the next few years:

- It may decide that the data warrant "off-cycle" regulation and promulgate legally enforceable standards before 2006.
- It may decide that no regulations are necessary.
- It may issue a health advisory consisting of 1-day, 10-day, and lifetime perchlorate concentrations (in drinking water) that are considered safe.
- It may decide to regulate and issue the advisory as an interim reference since the regulatory review process takes up to 3 1/2 years following the decision to regulate. The health advisory is not federally enforceable but instead offers guidance to state, tribal, and local officials. It is also subject to revision as new data come to light.

Nonfederal Standards

Several states have issued their own advisories for perchlorate concentrations in drinking water. Again, these are not legal standards. Though the list is in constant variance, as of July 2002, the following have been promulgated:

- California has lowered its 2002 Action Level from 18 ppb to 4 ppb and issued a Draft Public Health Goal of 18 ppb.
- New York has a two-tiered set of planning and action levels at 5 ppb and 18 ppb, respectively.
- Texas has lowered its 2001 action and residential cleanup level from 22 ppb to 4 ppb.
- Arizona has a 1998 health-based guidance level of 14 ppb.
- Massachusetts issued a 1 ppb precautionary recommendation for children and at-risk subpopulations to a local water district.
- New Mexico has a 1 ppb drinking water screening level.
- Nevada has an 18 ppb public notice standard.

Other levels are also set for specific Superfund sites. In California, for example, the cleanup concentration goal is 4 ppb at Superfund sites, while in Massachusetts, the goal is 1.5 ppb.

Tribes can also set their own standards; in 2002, the Chemehuevi Tribe on the Colorado River established a drinking water standard of 5 ppb.

Human and Environmental Effects

Perchlorate disrupts the thyroid gland by preventing its uptake of iodide, a key constituent in producing thyroid hormones. Since thyroid hormones regulate metabolism and are key to development, impairment can cause cognitive and developmental problems, as well as tumors. Toxicological data using laboratory animals, together with available human clinical data, indicate that perchlorate acts in mammalian species. Emerging data on ecotoxicological effects in fish and amphibians echo these effects and reinforce the critical role of thyroid hormones in development and growth.

In 1998, EPA's National Center for Environmental Assessment issued a draft toxicity assessment, *Perchlorate Environmental Contamination: Toxicological Review and Risk Characterization.* A panel of external scientific experts peer reviewed the assessment in 1999, and their recommendations were incorporated in the revised draft assessment issued in January 2002. This revision was again peer reviewed in March 2002 and a final document is expected in late 2002 or early 2003. This assessment will provide

the foundation for EPA-GW as it determines health advisory levels and whether to regulate.

Treatment

While treatment of perchlorate is an emerging emphasis, there are primarily two large-scale above-ground water treatment methods currently available: ion exchange and biological treatment.

Ion exchange replaces a more toxic ion with a less toxic ion. The replacement ions come from naturally occurring minerals or synthetic resins, which must be periodically regenerated or discarded. The La Puente Valley County Water District in Los Angeles County utilizes a 2,500 gallon per minute (gpm) system; another 23,500 gpm system is being constructed nearby as part of the Baldwin Park/San Gabriel Valley Superfund Site cleanup. Contaminated water at the La Puente site begins with perchlorate concentrations at 100 ppb, and the treated effluent is tested at less than 4 ppb. The capital cost for the La Puente ion exchange system was about $2 million; operational costs are about $145/acre-foot of water. A drawback is that this treatment creates waste brine that must also be treated.

The second leading treatment method is biological treatment, in which microbes reduce the chemical to a nontoxic or less toxic substance. However, some microbes require very specific conditions (anoxic, for example) and can require the introduction of certain nutrients. Also, to make treated water potable, secondary treatment is required. Finally, water utilities and regulators are typically much less familiar with biological treatment, so there is the added hurdle of proving the effectiveness to relevant officials before it will be considered acceptable.

Since 1998, an Aerojet-General Corporation facility in northern California has treated 3,600 gpm of perchlorate-contaminated water. The untreated concentration of about 2,500 ppb is lowered to less than 4 ppb after treatment. Capital costs are estimated at $5.5 million and operating costs at $65/acre-foot of water. Other technologies include reverse osmosis, biologically active carbon, abiotic reduction, and chemical reduction.

A good starting point for additional information about perchlorate is provided by Federal Remediation Technologies Roundtable. Go to http://www.blr.com/ keyword and type in **em573perchlorate** when prompted.

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